

CLAIMS

What is claimed is:

1. A method for producing dried foods, comprising:
circulating a heated gas around said food product until said food product has a
5 moisture content within the range of approximately zero to five percent.
2. A method as recited in claim 1, further comprising simultaneously
exposing said food product to ultrasonic waves and circulating said heated gas around
said food product.
3. A method as recited in claim 2, wherein said food product is exposed to
ultrasonic wavelengths within the range of approximately 20 KHz to approximately 100
10 KHz for approximately fifteen to ninety minutes.
4. A method as recited in claim 1, said method further comprising placing
said food product on a support substrate.
5. A method as recited in claim 1, wherein said circulated heated gas
comprises nitrogen.
6. A method as recited in claim 2, further comprising exposing said food
product to a second ultrasonic frequency and circulating heated gas at a second
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temperature for a second period of time.

7. A method as recited in claim 6, further comprising exposing said food product to a third ultrasonic frequency and circulating heated gas at a third temperature for a third period of time.

8. A method for producing dried foods, comprising:
exposing a food product to ultrasonic waves; and
circulating a heated gas around said food product until said food product has a moisture content within the range of approximately zero to five percent.

9. A method as recited in claim 8, wherein said steps of exposing said food product to ultrasonic waves and circulating a heated gas around said food product are performed simultaneously.

10. A method as recited in claim 8, wherein said food product is exposed to ultrasonic wavelengths within the range of approximately 20 KHz to approximately 100 KHz for approximately fifteen to ninety minutes.

11. A method as recited in claim 8, said method further comprising placing said food product on a support substrate.

12. A method as recited in claim 8, wherein said circulated heated gas is nitrogen.

13. A method as recited in claim 8, further comprising exposing said food
5 product to a second ultrasonic frequency and circulating heated gas at a second temperature for a second period of time.

14. A method as recited in claim 13, further comprising exposing said food
10 product to a third ultrasonic frequency and circulating heated gas at a third temperature for a third period of time.

15. A process for desiccating a material containing moisture, comprising:
placing said material onto a supporting substrate;
15 exposing said object to sound waves having a first ultrasonic wavelength for a first period of time;

simultaneously circulating a heated gas at a first temperature around said material for said first period of time;

exposing said prepared and sized material to sound waves having a second ultrasonic wavelength for a second period of time;

20 simultaneously circulating a heated gas at a second temperature around said material for said second period of time;

exposing said prepared and sized material to sound waves having a third

ultrasonic wavelength for said third period of time;

simultaneously circulating a heated gas at a third temperature around said material for third period of time; and

separating said material from said substrate.

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16. A method of desiccating a material containing moisture according to claim 15, wherein said heated gas is circulated around said material and said support substrate at a rate between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute per square foot.

17. A method of desiccating vegetables, comprising:
preparing and sizing the vegetables and placing the vegetables on a support substrate;

subjecting said vegetables to ultrasonic waves;

circulating air heated to a temperature of approximately 190° F to approximately 210° F around the vegetables for approximately fifteen minutes;

circulating heated air at a temperature of approximately 170° F to approximately 190° F around the vegetables for approximately 15 minutes;

circulating heated air at a temperature of approximately 150° F to approximately 170° F around the vegetables for about one hour until said vegetables have a moisture content of approximately 5%; and

removing the dehydrated vegetables from said support substrate.

18. A method of desiccating vegetables according to claim 17, wherein said heated air is circulated around said vegetables and said support substrate at a rate between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute per square foot.

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19. An apparatus for producing dried foods, comprising:
a housing having a drying chamber; and
means for circulating a heated gas around said food product until said food product has a moisture content within the range of approximately zero to five percent.

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20. An apparatus as recited in claim 12, further comprising means for exposing said food product to ultrasonic waves.

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21. An apparatus as recited in claim 20, wherein said means for circulating a heated gas around said food product and said means for exposing said food product to ultrasonic waves are configured to simultaneously expose said food product to said ultrasonic waves and said heated gas.

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22. An apparatus as recited in claim 20, wherein said means for exposing said food product to ultrasonic waves is configured for exposure at wavelengths within the range of approximately 20 KHz to approximately 100 KHz for approximately fifteen to ninety minutes.

23. An apparatus as recited in claim 19, further comprising a support substrate configured for carrying said food product.

24. An apparatus as recited in claim 19, wherein said circulated heated gas comprises nitrogen.

25. An apparatus for producing dried foods, comprising:
a housing having a drying chamber;
means for exposing a food product to ultrasonic waves; and
means for circulating a heated gas around said food product until said food product has a moisture content within the range of approximately zero to five percent.

26. An apparatus as recited in claim 25, wherein said means for circulating a heated gas around said food product and said means for exposing said food product to ultrasonic waves are configured to simultaneously expose said food product to said ultrasonic waves and said heated gas.

27. An apparatus as recited in claim 25, wherein said means for exposing said food product to ultrasonic waves is configured for exposure at wavelengths within the range of approximately 20 KHz to approximately 100 KHz for approximately fifteen to ninety minutes.

28. An apparatus as recited in claim 25, further comprising a support substrate configured for carrying said food product.

29. An apparatus as recited in claim 25, wherein said circulated heated gas
5 comprises nitrogen.

30. An apparatus for reducing the moisture content in a food product, comprising:

a housing;

10 said housing having a first drying zone and a second drying zone;

a conveyor;

said conveyor configured to move said food product through said first and
second drying zones;

a first heat source;

15 said first heat source configured to circulate heated gas through said first drying zone at a first temperature; and

a second heat source;

said second heat source configured to circulate heated gas through said second drying zone at a second temperature.

20 31. An apparatus as recited in claim 30, further comprising:

an ultrasound source;

said ultrasound source configured to expose said food product in at least one of said drying zones to ultrasonic waves.

32. An apparatus as recited in claim 30:

5 wherein said first heat source is configured to circulate said gas through said housing at a rate of between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute per square foot; and

10 wherein said second heat source are configured to circulate said gas through said housing at a rate of between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute per square foot.

33. An apparatus as recited in claim 30:

15 wherein said first heat source is configured to circulate gas through said first drying zone at a rate of rate of between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute per square foot; and

wherein said second heat source is configured to circulate gas through said second drying zone at a rate of rate of between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute per square foot.

20 34. An apparatus as recited in claim 30, further comprising:

a support substrate;

said support substrate configured to carry said food product.

35. An apparatus as recited in claim 34, wherein said support substrate comprises a plurality of spheres.

36. An apparatus as recited in claim 35, wherein said conveyor includes a plurality of vanes having an intermediate area containing said spheres.

37. An apparatus as recited in claim 35, wherein said spheres are held in a container placed on said conveyor.

38. An apparatus as recited in claim 31, wherein said ultrasonic source and at least one said heat source are configured to simultaneously expose said food product to said ultrasonic waves and said heated gas.

39. An apparatus as recited in claim 38, wherein said ultrasonic source is configured for exposure at wavelengths within the range of approximately 20 KHz to approximately 100 KHz for approximately fifteen to ninety minutes.

40. An apparatus for reducing the moisture content in a food product, comprising:

a housing;

said housing having a first drying zone and a second drying zone;

a conveyor;

said conveyor configured to move said food product through said first and second drying zones;

a first heat source;

said first heat source configured to circulate heated gas through said first drying

5 zone at a first temperature;

a second heat source;

said second heat source configured to circulate heated gas through said second drying zone at a second temperature; and

an ultrasound source;

10 said ultrasound source configured to expose said food product in at least one of said drying zones to ultrasonic waves.

41. An apparatus as recited in claim 40:

15 wherein said first heat source is configured to circulate said gas through said housing at a rate of between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute per square foot; and

wherein said second heat source are configured to circulate said gas through said housing at a rate of between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute per square foot.

20 42. An apparatus as recited in claim 40:

wherein said first heat source is configured to circulate gas through said first

drying zone at a rate of rate of between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute per square foot; and

wherein said second heat source circulates gas through said second drying zone at a rate of rate of between approximately 150 cubic feet per minute per square foot and
5 approximately 450 cubic feet per minute per square foot.

43. An apparatus as recited in claim 40, further comprising:
a support substrate;
said support substrate configured to carry said food product.

44. An apparatus as recited in claim 43, wherein said support substrate
comprises a plurality of spheres.

45. An apparatus as recited in claim 44, wherein said conveyor includes a
15 plurality of vanes having an intermediate area containing said spheres.

46. An apparatus as recited in claim 44, wherein said spheres are held in a
container placed on said conveyor.

20 47. An apparatus as recited in claim 40, wherein said ultrasonic source and at
least one said heat source are configured to simultaneously expose said food product to
said ultrasonic waves and said heated gas.

48. An apparatus as recited in claim 47, wherein said ultrasonic source is configured for exposure at wavelengths within the range of approximately 20 KHz to approximately 100 KHz for approximately fifteen to ninety minutes.

5 49. An apparatus for reducing the moisture content in a food product, comprising:

a housing;

said housing having first, second and third drying zones;

a conveyor;

10 said conveyor configured to move said food product through said drying zones;

a first heat source;

said first heat source configured to circulate heated gas through said first drying zone at a first temperature;

a second heat source;

15 said second heat source configured to circulate heated gas through said second drying zone at a second temperature;

a third heat source;

said third heat source configured to circulate heated gas through said third drying zone at a third temperature; and

20 an ultrasound source;

said ultrasound source configured to expose said food product in at least one of said drying zones to ultrasonic waves.

50. An apparatus as recited in claim 49:

wherein said first, second and third heat sources are configured to circulate said gas through said housing at a rate of between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute per square foot.

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51. An apparatus as recited in claim 49:

wherein said first heat source is configured to circulate gas through said first drying zone at a rate of rate of between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute per square foot;

wherein said second heat source is configured to circulate gas through said second drying zone at a rate of rate of between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute square foot; and

wherein said third heat source is configured to circulate gas through said third drying zone at a rate of rate of between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute per square foot.

52. An apparatus as recited in claim 49, further comprising:

a support substrate;

said support substrate configured to carry said food product.

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53. An apparatus as recited in claim 52, wherein said support substrate comprises a plurality of spheres.

54. An apparatus as recited in claim 53, wherein said conveyor includes a plurality of vanes having an intermediate area containing said spheres.

55. An apparatus as recited in claim 53, wherein said spheres are held in a container placed on said conveyor.

56. An apparatus as recited in claim 49, wherein said ultrasonic source and at least one said heat source are configured to simultaneously expose said food product to said ultrasonic waves and said heated gas.

57. An apparatus as recited in claim 56, wherein said ultrasonic source is configured for exposure at wavelengths within the range of approximately 20 KHz to approximately 100 KHz for approximately fifteen to ninety minutes.

58. An apparatus for reducing the moisture content in food material, comprising:

a housing;

said housing having at least one drying chamber;

means for exposing said food material to sound waves having a first ultrasonic wavelength for a first period of time and simultaneously circulating a heated gas at a first temperature around said material for said first period of time;

means for exposing said food material to sound waves having a second

ultrasonic wavelength for a second period of time and simultaneously circulating a heated gas at a second temperature around said material for said second period of time;

means for exposing said food material to sound waves having a third ultrasonic wavelength for said third period of time and simultaneously circulating a heated gas at a third temperature around said material for third period of time; and

means for separating said material from said substrate.

59. An apparatus for desiccating a food product, comprising:

an ultrasound source;

said ultrasound source configured to subject a food product to ultrasonic waves;

a first source of air heated to a temperature of approximately 190° F to approximately 210° F and configured to circulate heated air around the food product for approximately fifteen minutes;

a second source of air heated to a temperature of approximately 170° F to approximately 190° F and configured to circulate heated air around the food product for approximately fifteen minutes; and

a third source of air heated to a temperature of approximately 150° F to approximately 170° F and configured to circulate heated air around the vegetables for approximately one hour.

60. An apparatus as recited in claim 59, wherein said first, second and third sources of heated air are configured to said head air through said housing at a rate of between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute per square foot.

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61. An apparatus as recited in claim 59:

wherein said first source or air is configured to circulate heated air at a rate of rate of between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute per square foot; and

wherein said second source of air is configured to circulate heated air a rate of rate of between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute per square foot; and

wherein said third source of air is configured to circulate heated air at a rate of rate of between approximately 150 cubic feet per minute per square foot and approximately 450 cubic feet per minute per square foot.